3.2 Near-Facility Environmental Monitoring

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Several types of environmental media are sampled and various radiological measurements are taken near nuclear facilities to monitor the effectiveness of contamination control in waste management and restoration activities and effluent treatment and control practices. These include air, surface and spring waters, surface contamination, soil and vegetation, vadose zone monitoring, investigative sampling (which can include wildlife), and external radiation. Sampling and analysis information and analytical results for 1996 for each of these are summarized below. Additional data and more detailed information may be found in *Hanford Site Near-Facility Environmental Monitoring Annual Report, Calendar Year 1996* (Perkins et al. 1997).

Near-Facility Environmental Monitoring at the Hanford Site

Near-facility (near-field) environmental monitoring is defined as routine monitoring near facilities that have potential to discharge, or have discharged, stored, or disposed of radioactive or hazardous contaminants. Monitoring locations are associated with nuclear facilities, such as the Plutonium-Uranium Extraction Plant and N Reactor, and waste storage or disposal facilities, such as burial grounds, tank farms, ponds, cribs, trenches, and ditches.

Much of the monitoring program consists of collecting and analyzing environmental samples and methodically surveying areas near facilities releasing effluents and waste streams. The program also evaluates acquired analytical data, determines the effectiveness of facility effluent monitoring and controls, measures the adequacy of containment at waste disposal units, and detects and monitors unusual conditions. The program implements applicable portions of DOE Orders 5400.1, 5484.1, 5400.5, and 5820.2A; WAC 246-247; and 40 CFR 61.

Routine monitoring activities include sampling and monitoring ambient air, water from surface-water disposal units, external radiation dose rate, vadose zone, soil, sediment, vegetation, and animals. Some of the parameters typically monitored are pH, radionuclide concentrations, radiation exposure levels, and concentrations of selected hazardous chemicals. Samples are collected from known or expected effluent pathways. These pathways are generally downwind of potential or actual airborne releases and downgradient of liquid discharges. The routine activities of near-facility monitoring in 1996 are summarized in Table 3.2.1, which shows the type, quantity, and location of samples collected.

Waste disposal sites and the terrain surrounding them are surveyed to detect and characterize radioactive surface contamination. Routine survey locations include cribs, trenches, retention basin perimeters, pond perimeters, ditch banks, solid waste disposal sites (e.g., burial grounds, trenches), unplanned release sites, tank farm perimeters, stabilized waste disposal sites, roads, and firebreaks in and around the site operational areas.

Air Monitoring

Near-facility air sampling monitors the effectiveness of waste management and effluent treatment and controls in reducing effluents and emissions; these systems also monitor diffuse source emissions.

Collection of Air Samples and Analytes of Interest

Radioactivity in air was sampled by a network of continuously operating samplers at 58 locations near nuclear facilities: 4 in the 100-N Area, 4 the 100-K Area, 38 in the 200 Areas, 3 at the Environmental Restoration Disposal Facility, 4 at the 100-D,DR Area, 3 at the 100 B,C Area,

Table 3.2.1. Near-Facility Routine Environmental Samples and Locations, 1996

Sample Type	Total Number of Sample Locations	Operational Area						
		100-B,C	100-D,DR	100-K	100-N	ERDF[(a)]	200/600	300/400
Air	58	3	4	4	4	3	39[(b)]	1
Water	11	0	0	0	9	0	2	0
External radiation	156	0	5	11	54[(c)]	2	63	21
Soil	78	0	0	0	7	0	54	17
Vegetation	76	0	0	0	10	0	49	17

(a) Environmental Restoration Disposal Facility.
(b) Includes one station located at the Wye Barricade.
(c) Thirty thermoluminescent dosimeters and 24 survey points.

1 near the 300 Area Treated Effluent Disposal Facility, and 1 collocated with samplers operated by the Pacific Northwest National Laboratory and the Washington State Department of Health at the Wye Barricade in the 600 Area. To avoid duplication of sampling, the near-facility environmental monitoring program used existing Pacific Northwest National Laboratory air samplers in the 300 and 400 Areas. Results for these areas are reported in Section 4.1, "Air Surveillance," and are not discussed here. Air samplers were located primarily at or near (within approximately 500 m [1,500 ft]) sites and/or facilities having the potential for, or history of, environmental releases, with an emphasis on the prevailing downwind direction.

Samples were collected according to a schedule established before the monitoring year. Airborne particles were sampled at each of these stations by drawing air through a glass-fiber filter. The filters were collected biweekly, field surveyed for gross radioactivity, held for at least 7 days, and then analyzed for total alpha and beta activity. The 7-day holding period was necessary to allow for the decay of naturally occurring radionuclides that would otherwise obscure detection of longer-lived radionuclides associated with emissions from nuclear facilities. The total radioactivity measurements were used to indicate changes in trends in the near-facility environment.

For most radionuclides, the amount of radioactive material collected on a single filter during a 2-week sampling period was too small to be measured accurately. The accuracy of the sample analysis was increased by compositing the samples into biannual samples for each location. Each composite sample was analyzed for plutonium-238, plutonium-239,240, strontium-90, uranium-234, uranium-235, uranium-238, and gamma-emitting radionuclides (e.g., cesium-137, cobalt-60). Samples from the 100-K Area were also analyzed for americium-241 and plutonium-241.

Radiological Results for Air Samples

Of the radionuclide analyses performed, cesium-137, plutonium-239,240, strontium-90, and uranium were consistently detectable in the 100-N and 200 Areas. Cobalt-60 was consistently detectable in the 100-N Area. Air concentrations for these radionuclides were elevated near facilities compared to the concentrations measured offsite. Figure 3.2.1 shows average values for 1996 and the preceding 5 years for selected radionuclides compared to DOE derived concentration guides and the background air concentration as measured by the Pacific Northwest National Laboratory in distant communities. The DOE derived concentration guides (DOE Order 5400.5) are reference values that are used as indexes of performance (Appendix C, Table C.5). The data indicate a large degree of variability. In general, air samples collected from air samplers located at or directly adjacent to nuclear facilities had higher concentrations than did those samples collected farther away. The data also show that concentrations of certain radionuclides were higher within different operational areas. Generally, the predominant radionuclides are activation products (i.e., gamma emitters) in the 100 Areas and fission products in the 200 Areas.

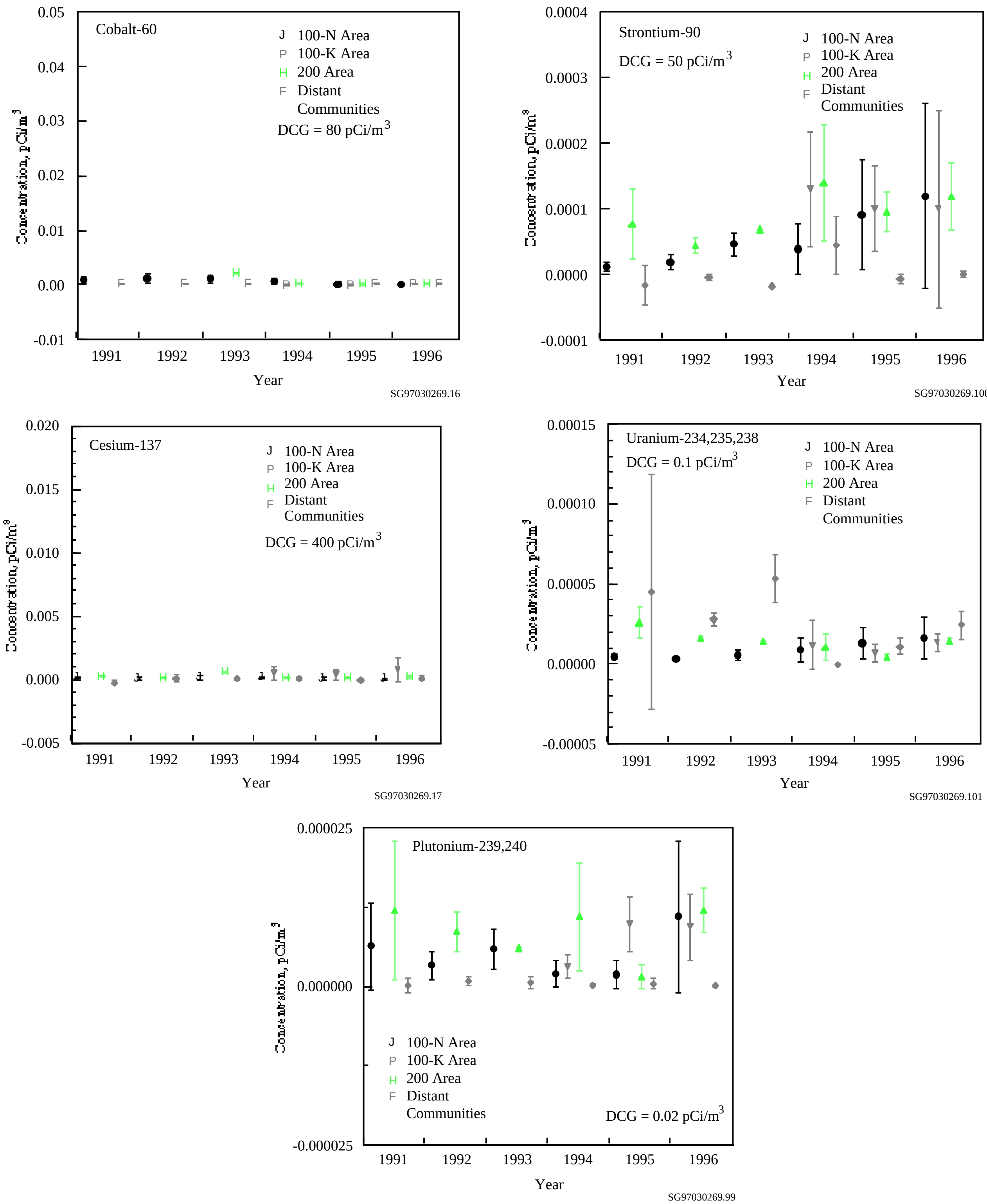

Figure 3.2.1. Concentrations (±2 standard error of the mean) of Selected Radionuclides in Near-Facility Air Samples Compared to Those in Distant Communities, 1991 Through 1996. As a result of figure scale, some uncertainties (error bars) are concealed by point symbol.

100-B,C Area

Near-facility air sampling was conducted at the 100-B,C remediation site through a network of three continuous air samplers. Monitoring began in July 1996, and the analytical results indicated that the concentrations were much less than the DOE derived concentration guides and only slightly greater than levels measured offsite.

100-D,DR Area

Near-facility air sampling was conducted at the 100-D,DR remediation site through a network of four continuous air samplers. Monitoring began in November 1996, and the analytical results indicated that the concentrations were much less than the DOE derived concentration guides and only slightly greater than levels measured offsite.

100-K Area

Analytical results from 100-K Area ambient air samples show quantities of strontium-90, cesium-137, plutonium-239,240, plutonium-241, and americium-241 that were slightly above detection levels. These levels were much less than the DOE derived concentration guides; however, they were greater than levels measured offsite. Facility emissions decreased substantially in 1996, and radionuclide concentrations seen in the ambient air samples were near detection limits. The 1996 results did not differ significantly from those measured in 1995.

100-N Area

Analytical results from ambient air samples taken in the 100-N Area continued to be at or near Hanford Site background concentrations for most radionuclides as a result of facility shutdowns and improved effluent controls and waste management practices. Concentrations were much less than the DOE derived concentration guides; however, they were slightly greater than levels measured offsite.

200 Areas

Analytical results from ambient air samples taken in the 200 Areas were at or near Hanford Site background concentrations for most radionuclides as a result of facility shutdowns, better effluent controls, and improved waste management practices. Although levels were much less than the DOE derived concentration guides, they were greater than those measured offsite. Levels of strontium-90, plutonium-239,240, and uranium were comparable to those measured in the 100-N Area.

Environmental Restoration Disposal Facility

Near-facility air sampling was conducted at the Environmental Restoration Disposal Facility remediation site through a network of continuous air samplers. This network utilized two existing Hanford Site monitors for upwind monitoring and was supplemented by three additional air monitors that provided downwind monitoring. Monitoring began in June 1996, and the analytical results indicated that the concentrations were much less than the DOE derived concentration guides and only slightly greater than levels measured offsite.

Surface-Water Disposal Units and 100-N Riverbank Springs Monitoring

Surface-water disposal units (open ponds and ditches) used by the operating facilities and springs along the 100-N Area Columbia River shoreline are monitored to assess the effectiveness of effluent and contamination controls. Two surface-water disposal units in the 200 Areas were sampled during 1996: the 200-East Area Powerhouse Ditch and the 216-B-3C Expansion Pond.

Collection of Surface-Water Disposal Unit and 100-N Riverbank Springs Samples and Analytes of Interest

Samples from surface-water disposal units and Columbia River shoreline springs were collected from various locations in the operational areas. Samples collected from surface-water disposal units included water, sediment, and aquatic vegetation. Only water samples were taken at river shoreline springs. The sampling methods are discussed in detail in *Operational Environmental Monitoring* (Westinghouse Hanford Company 1991a). To avoid duplication of sampling, the near-facility environmental monitoring program used surface-water sample data collected by the Pacific Northwest National Laboratory for the 400 Area. Results for the 400 Area sampling are reported in Section 4.2, “Surface Water and Sediment Surveillance,” and are not discussed here.

Radiological analyses of water samples from surface-water disposal units were performed onsite by the Waste Sampling and Characterization Facility in 1996. Analyses included uranium, tritium, strontium-90, plutonium-238, plutonium-239,240, and gamma-emitting radionuclides. Radiological analyses of sediment and aquatic vegetation samples were performed for uranium, strontium-90, plutonium-239,240, and gamma-emitting radionuclides. Nonradiological analyses were performed for pH, temperature, and nitrates. Analytes of interest were selected based on their presence in effluent discharges and their importance in verifying effluent control and determining compliance with applicable effluent discharge standards. Surface-water disposal units that received potentially radioactively contaminated effluents were within posted radiological control areas.

Radiological Results for Surface-Water Disposal Units

Radiological results for liquid samples from surface-water disposal units (ponds and ditches) located in the 200 Areas are summarized in Table 3.2.2. In all cases, radionuclide concentrations in surface-water disposal units were less than the DOE derived concentration guides.

Radiological results for aquatic vegetation and sediment samples taken from surface-water disposal units located in the 200 Areas are summarized in Tables 3.2.3 and 3.2.4, respectively. Although there were some elevated levels in both aquatic vegetation and sediment, in all cases the results were much less than the standards cited in the *Hanford Site Radiological Control Manual* (HSRCM 1994).

Table 3.2.2. Radiological Results for Liquid Samples from Surface-Water Disposal Units (pCi/L), 200 Areas, 1996

Sample Location	Number of Samples		$^{3}H^{(a)}$	^{90}Sr	^{137}Cs	^{238}Pu	$^{239,240}Pu$	$^{Total}U$
200-East Powerhouse Ditch	12	Mean	1.7×10^{2}	1.2×10^{-4}	ND[b]	ND	$<3.7 \times 10^{-5}$	3.8×10^{-4}
		Maximum	3.8×10^{2}	1.2×10^{-3}	ND	ND	2.0×10^{-4}	7.7×10^{-4}
216-B-3C Expansion Pond (200-East Area)	12	Mean	2.0×10^{2}	1.5×10^{-3}	ND	2.0×10^{-4}	1.7×10^{-5}	2.0×10^{-4}
		Maximum	4.7×10^{2}	1.5×10^{-3}	ND	2.0×10^{-4}	1.7×10^{-5}	5.2×10^{-4}
		DCG[c]	$2.0 \times 10^{6(d)}$	1,000	3,000	40	30	500

(a) The detection limit for tritium is 300 pCi/L .
(b) ND = Not detected.
(c) DCG = DOE derived concentration guide (DOE Order 5400.5).
(d) Using uranium-234 as the most limiting DCG.

Table 3.2.3. Radiological Results for Aquatic Vegetation Samples from Surface-Water Disposal Units (pCi/g, dry wt), 200 Areas, 1996

Sample Location	Number of Samples	^{90}Sr	^{137}Cs	$^{239,240}Pu$	$^{Total}U$ (g/g)
216-B-3C Expansion Pond (200-East Area)	1	0.35	0.47	0.23	2.4×10^{-9}
200-East Powerhouse Ditch	1	0.73	ND[a]	0.48	3.4×10^{-9}

(a) ND = Not detected.

Table 3.2.4. Radiological Results for Sediment Samples from Surface-Water Disposal Units (pCi/g, dry wt), 200 Areas, 1996

Sample Location	Number of Samples	^{90}Sr	^{137}Cs	$^{239,249}Pu$	$^{Total}U$ (g/g)
216-B-3C Expansion Pond (200-East Area)	1	3.8	7.9	0.78	1.9×10^{-10}
200-East Powerhouse Ditch	1	0.26	0.076	4.30	3.0×10^{-9}

Radiological Results for 100-N Riverbank Springs

In the past, radioactive effluent streams sent to the 1301-N and 1325-N Liquid Waste Disposal Facilities in the 100-N Area contributed to the release of radionuclides to the Columbia River through their migration with the groundwater. Radionuclides enter the Columbia River along the riverbank region known as N Springs. Releases into the river at N Springs are calculated based on analysis of weekly samples collected from monitoring well 199-N-46 located near the shoreline. A more detailed discussion of the release calculations may be found in *Environmental Releases for Calendar Year 1996* (Gleckler et al. 1997).

Groundwater springs along the 100-N Area shoreline are sampled annually to verify that the reported radionuclide releases to the Columbia River are conservative (i.e., not under reported). To verify releases, conservatively high radionuclide concentrations in samples collected from well 199-N-46 are used, multiplied by the estimated groundwater discharge into the river. The N Springs groundwater flow rate was estimated using a computer model developed by Gilmore et al. (1992). The estimated groundwater flow rate used to calculate 1996 releases from N Springs was 43 L/min (11 gal/min). The results of characterizing the radionuclide concentrations in the springs along the shoreline can then be compared to the concentrations measured in well 199-N-46 to ensure that the well is located in the groundwater migration route that has the highest concentrations of radionuclides.

In 1996, the concentrations detected in samples from shoreline springs were highest in springs nearest well 199-N-46. All of the concentrations were lower than those measured in the well. The data from shoreline springs sampling are summarized in Table 3.2.5.

Table 3.2.5. Concentration (pCi/L) of Radionuclides in 100-N Area Columbia River Shoreline Springs, 1996

Radionuclide	Facility Effluent Monitoring Well 199-N-46	Shoreline Springs Maximum	Shoreline Springs Average	DCG[a]
Tritium	20,000	16,100	2,490	2,000,000
Cobalt-60	NA[b]	5.84	1.85	5,000
Strontium-90	14,000	5,780	811	1,000

(a) DCG = DOE derived concentration guide (DOE Order 5400.5).
(b) NA = Not analyzed.

Nonradiological Results for Surface-Water Disposal Units

Nonradiological results for water samples taken from surface-water disposal units located in the 200 Areas are summarized in Table 3.2.6. The results for pH were well within the pH standard of 2.0 to 12.5 for liquid effluent discharges based on the discharge limits listed in the Resource Conservation and Recovery Act. The analytical results for nitrates were all less than the 45-mg/L state and federal drinking water standard for public water supplies (WAC 246-249, 40 CFR 141).

Radiological Surveys

Radiological surveys are used to monitor and detect radiological contamination on the Hanford Site. The two main types of posted radiological controlled areas are underground radioactive material and contamination areas.

Underground radioactive material areas are posted areas with contamination contained below the soil surface. These areas are typically stabilized cribs, burial grounds,

Table 3.2.6. Nonradiological Results for Water Samples from Surface-Water Disposal Units, 200 Areas, 1996

	pH				Nitrate (NO_3), mg/L		
Sample Location	No. of Samples	Mean	Maximum	Minimum	No. of Samples	Mean	Maximum
200-East Powerhouse Ditch	52	8.2	8.7	6.6	4	0.17	0.32
216-B-3C Expansion Pond (200-East Area)	52	8.9	9.3	7.8	4	0.16	0.32

and covered ponds, trenches, and ditches. Barriers over the contamination sources are used to inhibit radionuclide transport to the surface environs. These areas are surveyed at least annually to document the current radiological status. The radiologically contaminated areas have been reposted to meet the new requirements outlined in HSRCM (1994). The postings include contamination, high contamination (activity of >100,000 dpm/100 cm^2 beta/gamma or >10,000 dpm/100 cm^2 alpha), soil contamination, underground radioactive material, radiological buffer, and radiation/high radiation. For continuity between annual reports issued in 1995 and 1996, the use of contamination area in this report includes contamination, high contamination, and soil contamination areas.

Contamination/soil contamination areas may or may not be associated with an underground radioactive material structure. A breach in the barrier of an underground radioactive material area may result in the growth of contaminated vegetation. Insects or animals may burrow into an underground radioactive material area and bring contamination to the surface. Vent pipes or risers from an underground structure may be a source of speck contamination. Fallout from stacks or unplanned releases from previously operating facilities may contaminate an area that is not related to a subsurface structure. All types of contamination areas may be susceptible to contamination migration. All known contamination areas are surveyed at least annually to document the current radiological status.

In 1996, the Hanford Site had approximately 4,016 ha (9,923 acres) of posted outdoor contamination areas and 550 ha (1,360 acres) of posted underground radioactive material areas not including active facilities. The number of hectares (acres) of contamination areas is approximately eight times larger than the underground radioactive material areas. This is primarily because of the BC Cribs controlled area located south of the 200-East Area. This area was initially posted as a radiologically controlled area in 1958 because of widespread speck contamination and encompassed approximately 1,000 ha (2,500 acres). Additional investigative surveys were conducted adjacent to the BC Cribs controlled area in 1996, and the area was enlarged to 3,831 ha (9,466 acres). Table 3.2.7 lists the acreage for contamination areas and underground radioactive material areas, showing the net change from 1995 to 1996. A global positioning system was used in 1996 to measure the surface areas more accurately than in past years. Area measurements for 1996 have been entered into the Hanford Geographical Information System, maintained by the environmental restoration contractor.

The posted contamination areas vary between years because of an ongoing effort to clean, stabilize, and remediate areas of known contamination. During this time, new areas of contamination are also being identified. Table 3.2.8 indicates the changes resulting from stabilization activities during 1996. Approximately 21 ha (52 acres) were reclassified from contamination/soil contamination areas to underground radioactive material areas and 2,831 ha (6,995 acres) were posted as soil contamination areas. This large increase in contamination/soil contamination area is due to posting changes in the BC Cribs controlled area (Figure 3.2.2). Newly identified areas may have resulted from contaminant migration or an increased effort to investigate outdoor areas for radiological contamination. Vehicles equipped with radiation detection devices and an ultrasonic ranging and data system have identified areas of contamination that were previously undetected.

It was estimated that the external dose rate at 80% of the identified outdoor contamination areas was less than 1 mrem/h, though direct dose rate readings from isolated radioactive specks (a particle with a diameter less than 0.6 cm [0.25 in.]) could have been considerably higher.

Table 3.2.7. Outdoor Contamination Status, 1996

Hanford Site Area	Contamination Areas,[a] ha (acres)		Net Change,[b] ha (acres)		Underground Radioactive Material Areas,[c] ha (acres)		Net Change,[b] ha (acres)	
100-B,C	8	(20)		0	39	(96)		0
100-D,DR	0.1	(0.2)	-3	(7)	39	(96)	3	(7)
100-F	0.7	(1.7)	-7	(17)	33	(82)	3	(7)
100-H	0.4	(1)		0	14	(35)	1	(2)
100-K	8	(20)	5	(12)	53	(131)	-7	(17)
100-N	29	(73)		0	0.2	(0.5)		0
200-East[d]	64	(158)	-2,194	(5,421)	137	(339)	-14	(35)
200-West[d]	35	(86)	-166	(410)	194	(479)	-483	(1,193)
300	20	(49)	-1	(2)	14	(35)	1	(2)
400		0		0		0		0
600[e]	3,850	(9,513)	3,850	(9,513)	28	(69)	22	(54)
Totals	4,016	(9,923)	1,484	(3,667)	550	(1,360)	-474	(1,171)

(a) Includes areas posted as contamination/soil contamination or as radiologically controlled and areas that had both underground and contamination/soil contamination.
(b) - = Decreases.
(c) Includes areas with only underground contamination. Does not include areas that had contamination/soil contamination as well as underground radioactive material.
(d) Includes tank farms.
(e) Includes BC Cribs controlled area and waste disposal facilities outside the 200-East Area boundary that received waste from 200-East Area facilities (e.g., 216-A-25, 216-B-3) and waste disposal facilities outside the 200-West Area boundary that received waste from 200-West Area facilities (e.g., 216-S-19, 216-U-11).

Table 3.2.8. Zone Status Change of Posted Contamination Areas, 1996

Location	Zone Change	Area, ha (acres)	
100 Areas	CA to URM[a]	11	(27)
200-East Area	CA to URM	0.5	(1)
200-West Area	CA to URM	3	(11)
300 Area	CA to URM		0
400 Area	CA to URM		0
600 Area	CA to URM	7	(17)
600 Area	NONE to CA	2,831	(6,995)

(a) CA = Contamination/soil contamination area.
URM = Underground radioactive material area.

Contamination levels of this magnitude did not significantly add to dose rates for the public or Hanford Site workers in 1996.

Soil and Vegetation Sampling from Operational Areas

Soil and vegetation samples were collected on or adjacent to waste disposal units and from locations downwind and near or within the boundaries of the operating facilities. Samples were collected to detect potential migration and deposition of facility effluents. Special samples were also taken where physical or biological transport problems were identified. Migration can occur as the result of resuspension from radioactively contaminated surface areas, absorption of radionuclides by the roots of vegetation growing on or near underground and surface-water disposal units, or by waste site intrusion by animals.

Figure 3.2.2. Enlarged Soil Contamination Area South of the 200-East Area

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In 1994, routine annual soil and vegetation sampling was eliminated in the 100 Areas, except for the 100-N Area. Historical data indicated that the 100 Area sites previously monitored exhibited no signs of contamination migration, and continued monitoring would not be cost effective. In 1996, the number of sampling locations was reduced by approximately 50%. The sites that continue to be used are those nearest the liquid waste disposal facilities. Soil sampling in the 200 Areas was modified in 1994 to be more cost effective. Fifty-four soil samples are collected at alternating locations each year. The results of the sampling effort are discussed below.

Collection of Soil and Vegetation Samples and Analytes of Interest

The sampling methods and locations used are discussed in detail in Westinghouse Hanford Company (1991a). Radiological analyses of soil and vegetation samples included strontium-90, plutonium-239,240, uranium, and gamma-emitting radionuclides.

Radiological Results for Soil Samples

Of the radionuclide analyses performed, cobalt-60, strontium-90, cesium-137, plutonium-239,240, and uranium were consistently detectable. Soil concentrations for these radionuclides were elevated near and within facility boundaries when compared to concentrations measured offsite in 1996. Figure 3.2.3 shows average soil values for 1996 and the preceding 5 years. The concentrations show a large degree of variability. In general, concentrations in samples collected on or directly adjacent to waste disposal facilities were significantly higher than concentrations in samples collected farther away. The data also show, as expected, that concentrations of certain radionuclides were higher within different operational areas when compared to concentrations measured in distant communities. Generally, the predominant radionuclides were activation products and strontium-90 in the 100-N Area, fission products in the 200 Areas, and uranium in the 300 Area.

100-N Area

As a result of the shutdown of N Reactor and associated facilities, the analytical results from soil samples collected in the 100-N Area in 1996 generally exhibit concentrations at or near historical onsite levels. However, contamination levels were greater than those measured offsite, and the concentrations of cobalt-60 were greater than those measured in the 200 and 300/400 Areas. The cobalt-60 in the 100-N Area soils resulted from past discharges to waste disposal structures, primarily the 1301-N Liquid Waste Disposal Facility.

200 Areas

Analytical results from soil samples taken in the 200 Areas were on a downward trend for most radionuclides as a result of facility shutdowns, better effluent controls, and improved waste management practices. However, for strontium-90, cesium-137, and plutonium-239,240, the results were greater than those measured offsite and were higher compared to values from the 100 and 300/400 Areas.

300/400 Areas

Analytical results from soil samples taken in the 300/400 Areas were compared to results for other operational areas and to those measured offsite. Uranium levels for the 300/400 Areas were higher than those measured from the 100 and 200 Areas and slightly lower than levels measured in 1995. Uranium was expected in these samples because it was used during past fuel fabrication operations in the 300 Area.

Radiological Results for Vegetation Samples

Of the radionuclide analyses performed, cobalt-60, strontium-90, cesium-137, plutonium-239,240, and uranium were consistently detectable. Concentrations of these radionuclides in vegetation were elevated near and within facility boundaries compared to the concentrations measured offsite in 1996. Figure 3.2.4 shows average vegetation values for 1996 and the preceding 5 years. The concentrations show a large degree of variability. In general, concentrations in samples collected on or directly adjacent to the waste disposal facilities were higher than concentrations in samples collected farther away. As with the soil samples, the data show that certain radionuclides were found in higher concentrations in vegetation within different operational areas when compared to concentrations measured in distant communities in 1996. Except for strontium-90 (a fission product) detected in vegetation at the 100-N Area, the predominant radionuclides are generally activation products in the 100 Areas, fission products in the 200 Areas, and uranium in the 300 Area).

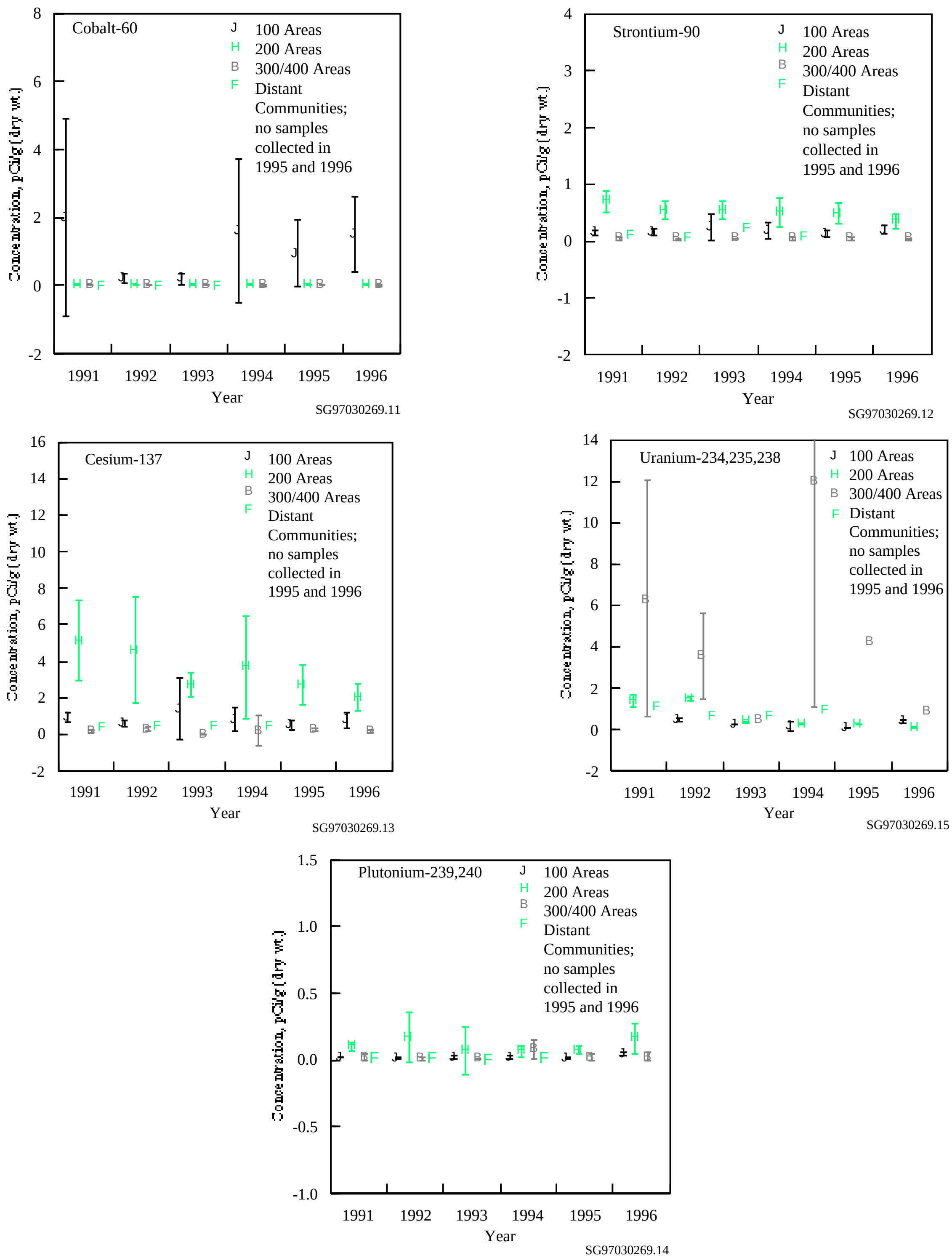


Figure 3.2.3. Average Concentrations (±2 standard error of the mean) of Selected Radionuclides in Near-Facility Soil Samples Compared to Those in Samples in Distant Communities, 1991 Through 1996. As a result of figure scale, some uncertainties (error bars) are concealed by point symbols. The 1994, 1995, and 1996 100 Areas data include the 100-N Area only.

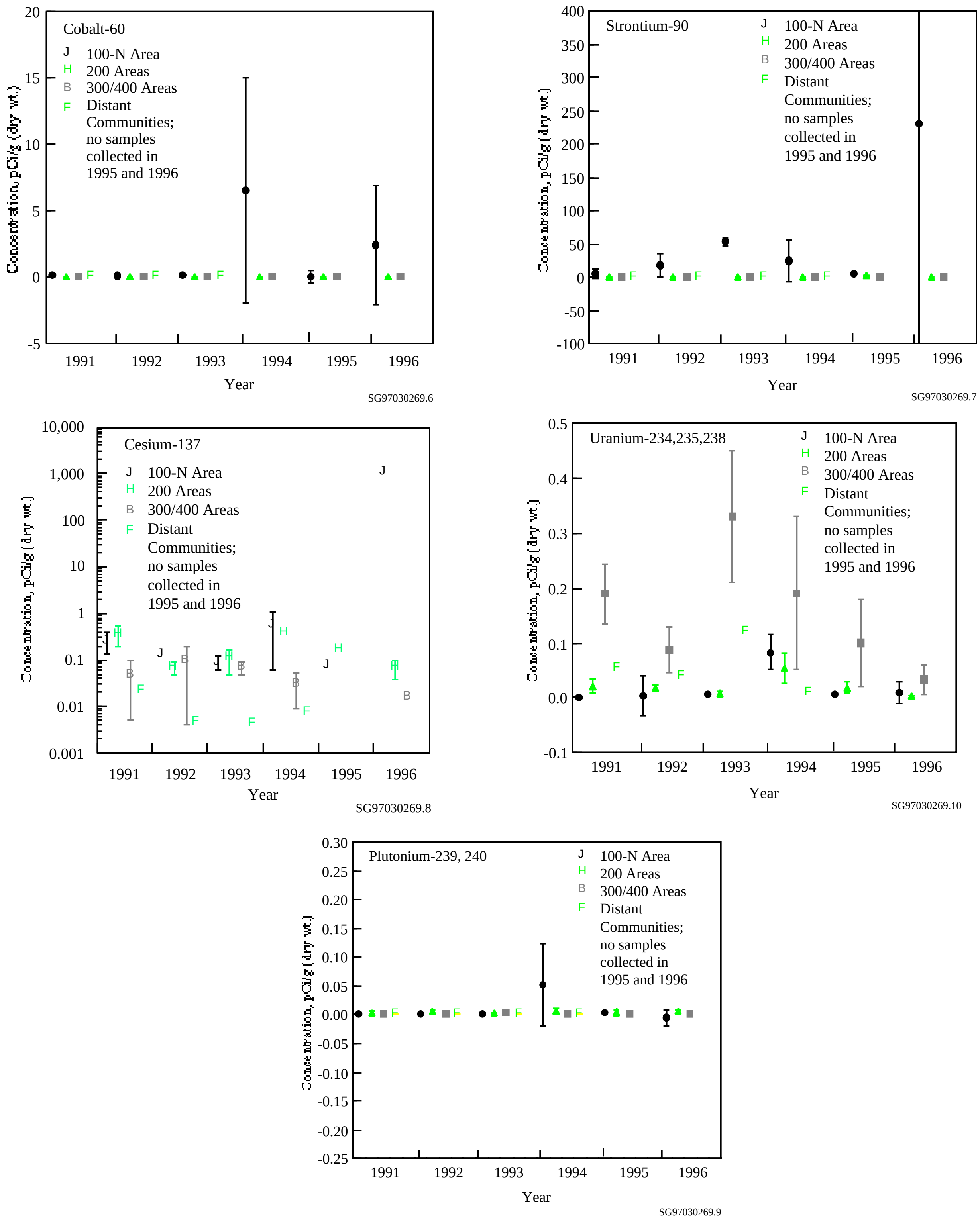


Figure 3.2.4. Average Concentrations (±2 standard error of the mean) of Selected Radionuclides in Near-Facility Vegetation Samples Compared to Those in Samples in Distant Communities, 1991 Through 1996. As a result of figure scale, some uncertainties (error bars) are concealed by point symbols. The 1994, 1995, and 1996 100 Areas data include the 100-N Area only.

100-N Area

Analytical results from vegetation samples collected in the 100-N Area in 1996 were comparable to those seen in 1995, with one notable exception observed at a sampling location near the retired 1301-N Liquid Waste Disposal Facility. This sample displayed elevated concentrations of cobalt-60, strontium-90, and cesium-137 and slightly elevated concentrations of plutonium-238 and plutonium-239,240. Otherwise, the values observed for strontium-90 in samples collected near the N Springs were typically higher than those seen in the remaining locations at 100-N Area. Generally, 1996 radionuclide levels in 100-N Area vegetation were greater than those measured offsite and levels for cobalt-60 and strontium-90 were higher compared to the 200 and 300/400 Areas.

200 Areas

Analytical results from vegetation samples taken in 1996 in the 200 Areas were comparable to those seen in 1995. Before 1992, radionuclide levels in these areas were greater than those measured offsite and were higher for cesium-137 and plutonium-239,240 compared to the 100 and 300/400 Areas. During 1996, the average concentrations for cesium-137 and plutonium-239,240 were similar onsite, offsite, and within the various operational areas.

300/400 Areas

Generally, the levels of most radionuclides measured in the 300 Area were greater than those measured offsite, and uranium levels were higher compared to the 100 and 200 Areas. The higher uranium levels were expected because uranium was released during past fuel fabrication operations in the 300 Area. The levels measured in the 400 Area were at or near those measured offsite.

External Radiation

External radiation fields were monitored near facilities and waste handling, storage, and disposal sites to measure, assess, and control the impacts of operations.

Radiological Field Measurements

Two methods are used for measuring external radiation fields. Hand-held meters are used at individual points of interest to give real-time assessments. Thermoluminescent dosimeters are used at numerous fixed locations to gather dose rate information over longer periods of time. Thermoluminescent dosimeter results can be used individually or averaged to determine dose rates in a given area for a particular sampling period. Specific information about external radiation sampling methods and locations can be found in Westinghouse Hanford Company (1991a).

Results of Radiological Field Measurements

Radiation Surveys

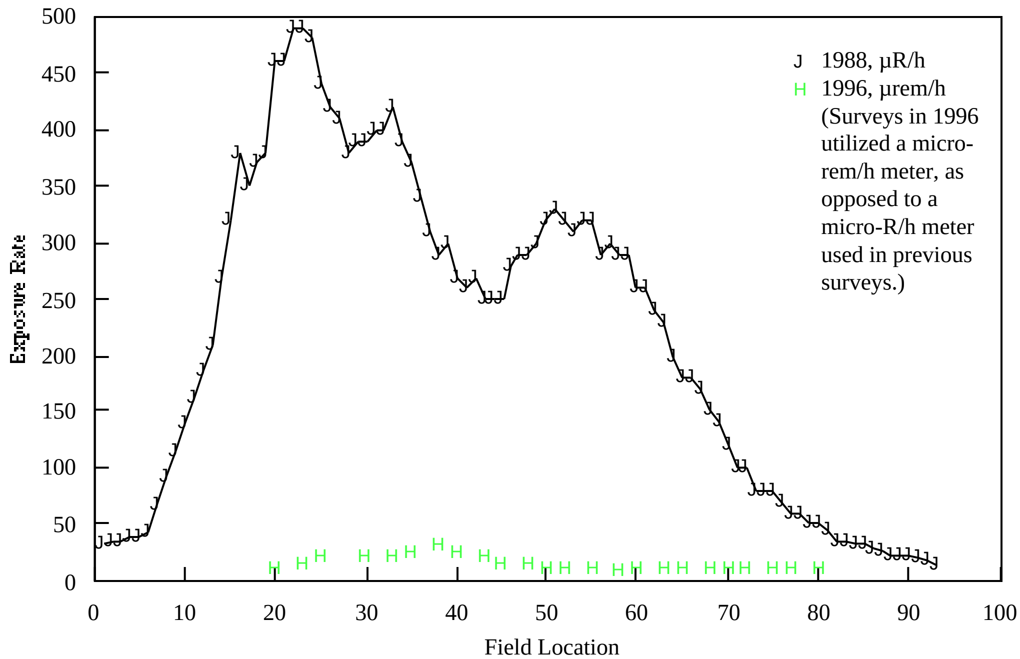
A hand-held micro-rem meter was used to survey points along the N Springs. Radiation measurements were taken at a height of approximately 1 m (3.28 ft). Prior to 1995, a micro-R meter was used for this survey. This instrument is known to over respond to low-energy gamma radiation. Since 1995, the micro-rem meter has been used to provide a more accurate measurement of the exposure rate. Figure 3.2.5 shows the overall shape of the curve for 1996, which indicates that N-Springs shoreline areas with the highest exposure rate are, as in the past, juxtapositional with the 1301-N Liquid Waste Disposal Facility.

Thermoluminescent Dosimeters

100-D,DR Area. Five new thermoluminescent dosimeter monitoring sites were established in the 100-D,DR Area at the end of the third quarter of 1996 to evaluate environmental restoration activities at the 116-D-7 and 116-DR-9 Liquid Waste Disposal Facilities. Because only 48 days of data were collected at these sites during 1996, the thermoluminescent dosimeter results were extrapolated to 1 year, resulting in an average of 88 mrem/yr, which is comparable to offsite ambient background levels. Table 3.2.9 summarizes the 1996 results.

100-K Area. This is the fourth year that thermoluminescent dosimeters have been placed in the 100-K Area, surrounding the K Basins and adjacent reactor buildings. Three of the thermoluminescent dosimeters have, as expected, shown consistently elevated readings (ranging from 3.5 to 24 times greater than the overall 100-K Area average) because of their proximity to radioactive waste storage areas or stored radioactive rail equipment. Table 3.2.9 summarizes the 1996 results.

100-N Area. The 1996 thermoluminescent dosimeter results indicate that direct radiation levels are highest



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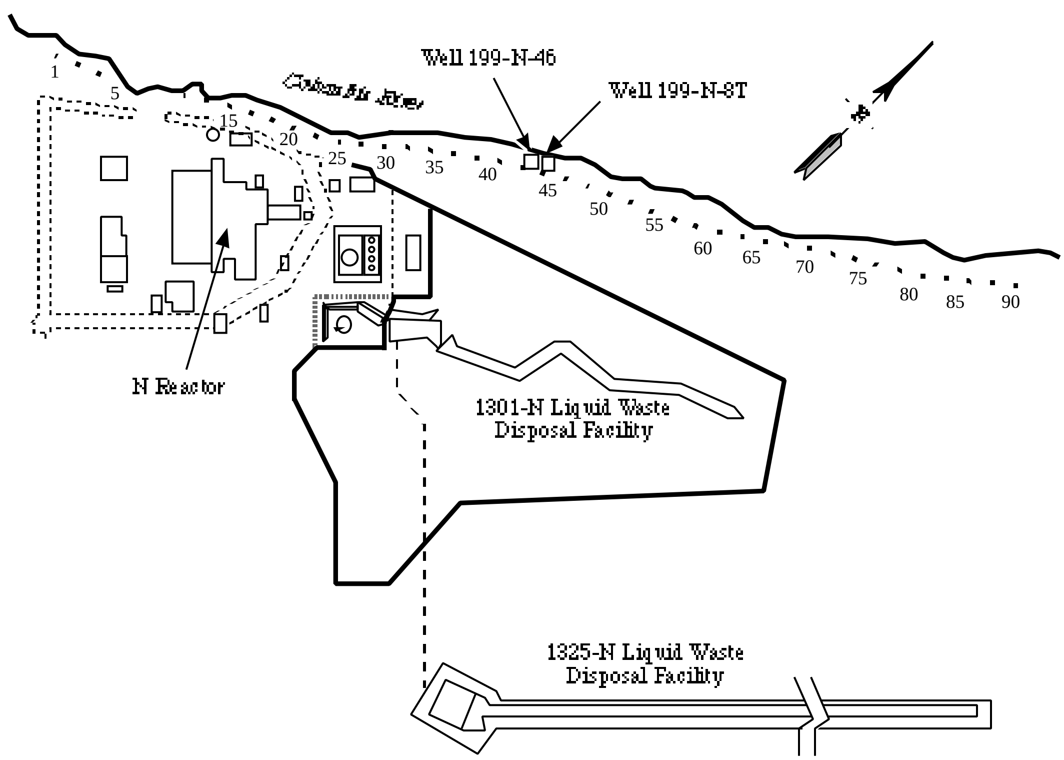

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Figure 3.2.5. Radiation Survey Measurements Along the 100-N Area Shoreline, 1988 and 1996

Table 3.2.9. Thermoluminescent Dosimeter Results for Waste Handling Facilities in the Operations Areas (mrem/yr, based on 24 h/d), 1995 and 1996

Area	Number of Locations, 1996	1995 Maximum	1995 Mean	1996 Maximum	1996 Mean	% Change[(a)]
100-D[(b)]	5	NA[(c)]	NA	92	88	NA
100-K	11	2,800	390	2,250	480	23
100-N	30 (23)[(d)]	13,000	1,300	9,200	1,150	-11
200/600	63	700	120	500	120	0
ERDF[(e)]	2	NA	NA	100	100	NA
300	8	310	140	240	120	-14
300 TEDF[(f)]	6	84	81	87	85	5
400	7	81	77	92	83	8

(a) Numbers indicate a decrease (-) or increase from the 1995 mean.
(b) Thermoluminescent dosimeter (TLD) network established for fourth quarter of 1996.
(c) Not applicable.
(d) Seven TLDs were removed from the 100-N network as a result of budget cuts prior to the third quarter of 1996.
(e) ERDF = Environmental Restoration Disposal Facility.
(f) TEDF = Treated Effluent Disposal Facility.

near facilities that had contained or received liquid effluent from N Reactor. These facilities primarily include the 1301-N and 1325-N Liquid Waste Disposal Facilities. While the results for these two facilities were noticeably higher than those for other 100-N Area thermoluminescent dosimeter locations, they were approximately 9% lower than exposure levels measured at these locations in 1995. Overall, dose rates measured at all locations in the 100-N Area in 1996 were approximately 13% lower than those measured in 1995. Decreases are the result of decay of the radionuclide inventories in the facilities and deactivation activities that occurred in 1996. The results of the 100-N Area thermoluminescent dosimeter readings are presented in Table 3.2.9.

200 Areas. Table 3.2.9 summarizes the results for the 63 thermoluminescent dosimeter locations used in 1995 and 1996 in the 200/600 Areas. The highest dose rates were measured near waste handling facilities such as tank farms. The highest dose rate was measured at the 241-A Tank Farm complex located in the 200-East Area. The average annual dose rate measured in 1996, 120 mrem/yr, was similar to the 1995 measurement.

Environmental Restoration Disposal Facility. Two new thermoluminescent dosimeter monitoring sites were established in the Environmental Restoration Disposal Facility at the end of the third quarter of 1996 to evaluate environmental restoration disposal activities. Because data for only one quarter were collected at these sites during 1996, there is no comparative information available. The thermoluminescent dosimeter analyses results were extrapolated to 1 year, resulting in an average of 100 mrem/yr.

300/300 Treated Effluent Disposal Facility/ 400 Areas. Table 3.2.9 compares 1996 thermoluminescent dosimeter results to those of 1995 for these areas and facilities. The highest dose rates in the 300 Area were measured near the 340 Waste Handling Facility. The average annual dose rate measured in the 300 Area in 1996 was 120 mrem/yr, which is a decrease of 14% compared to the average dose rate of 140 mrem/yr measured in 1995. The average annual dose rate at the 300 Area Treated Effluent Disposal Facility in 1996 was 85 mrem/yr, which is an increase of 5% compared to the average dose rate of 81 mrem/yr measured in 1995. The average annual dose rate measured in the 400 Area in 1996 was 83 mrem/yr, which is an increase of 8% compared to the average dose rate of 77 mrem/yr measured in 1995.

Investigative Sampling

Investigative sampling was conducted in the operations areas to confirm the absence or presence of radioactive and/or hazardous contaminants. Investigative sampling took place near facilities such as storage and disposal sites for at least one of the following reasons:

- to follow up radiological surface surveys that had indicated radioactive contamination was present
- to conduct preoperational surveys that quantify the radiological/hazardous conditions at a site before facility construction or operation
- to quantify the radiological condition of a site before remediation
- to determine if biotic intrusion (e.g., animal burrows or deep-rooted vegetation) had created a potential for contaminants to spread
- to determine the integrity of waste containment systems.

The maximum concentrations of radioactive isotopes from samples collected during these investigations are included in this report. Complete results, including counting errors, for these investigations, including field instrument and dose readings, where appropriate, are provided in Perkins et al. (1997).

Generally, the predominant radionuclides discovered during these efforts were activation products and strontium-90 in the 100 Areas, fission products in the 200 Areas, and uranium in the 300 Area. Hazardous chemicals generally have not been identified above background levels in preoperational environmental monitoring samples.

Collection of Investigative Samples and Analytes of Interest

Investigative samples collected in 1996 included paint chips, soil (including radioactive specks), vegetation (primarily tumbleweeds), freshwater clams, a caterpillar, a honey bee comb, darkling beetles, a harvester ant mound, a Western toad, a gopher snake, rock dove (domestic pigeon) feces, owl pellets, starlings, northern pocket gophers, mouse feces, and deer mice (Table 3.2.10).

Methods for collecting or otherwise obtaining investigative samples are described in Westinghouse Hanford Company (1991a). Field monitoring was conducted to detect radioactivity before samples were collected. Field monitoring results are expressed as counts per minute when a Geiger-Müeller detector is used or as millirad per hour when an ion chamber is used. Laboratory sample analysis results are generally expressed in picocuries per gram (pCi/g), except for extremely small samples and then in pCi per sample (pCi/sample). Maximum concentrations, rather than averages, are presented in this subsection; however, because of the high error values that result in less than (<) values, these less than numbers are not cited in the text when maximum values are being discussed.

Radiological Results for Investigative Samples

Investigative samples (e.g., paint chips, soil, etc.) were collected where known or suspected radioactive contamination was present or to verify radiological conditions at project sites. In 1996, 53 samples, comprising approximately 70 individual specimens, were analyzed for radionuclides and 43 showed measurable levels of contamination. Another 62 contamination incidents were reported, and the material was disposed of without isotopic analyses (though field instrument readings were recorded) during cleanup operations. A detailed data summary of all known radioactive contamination incidents in the operations areas during 1996 is provided in Perkins et al. (1997).

Paint Chips

In 1996, two instances occurred where contaminated paint chips, one from the east perimeter fence of the TX Tank Farm and another from the southeast perimeter fence of the SX Tank Farm, both in the 200-West Area, were found during routine radiation surveys. The contamination was cleaned up and the TX Tank Farm sample was submitted for radionuclide analyses. The highest radionuclide concentrations were cesium-137 (780,000 pCi/g) and strontium-90 (2,400 pCi/g). Analytical results are provided in Table 3.2.10.

Soil

In 1996, five investigative soil samples were collected, one from a slightly contaminated ant mound near the

Table 3.2.10. Investigative Samples Collected from the Operational Areas, 1996

Sample Type	Collection Area (Number of Samples)	Elevated Radionuclide	Maximum Concentration, pCi/g
Paint chips	200-West Area (1)	^{60}Co	<78
	(10-g sample)	^{90}Sr	2,400
		^{137}Cs	780,000
		^{238}Pu	<53
		^{239,240}Pu	<53
		^{Total}U	0.33
Soil	200-East Area (2)	^{60}Co	<2.3
		^{90}Sr	53
		^{137}Cs	7,200
		^{238}Pu	<7.9
		^{239,240}Pu	<7.9
		^{Total}U	0.15
Soil	200-West Area (2)	^{60}Co	<0.047
		^{90}Sr	370
		^{137}Cs	0.23
		^{238}Pu	<230
		^{239,240}Pu	<230
		^{Total}U	0.03
Ant mound	200-East Area (1)	^{60}Co	<0.21
(soil)		^{90}Sr	42
		^{137}Cs	28
		^{238}Pu	<0.059
		^{239,240}Pu	0.12
		^{Total}U	0.009
Mosses and	200-West Area (2)	^{60}Co	<0.067
lichens		^{90}Sr	0.74
		^{137}Cs	0.55
		^{238}Pu	<180
		^{239,240}Pu	120
		^{Total}U	0.019
Vegetation	200-East Area (1)	^{60}Co	<4.1
		^{90}Sr	7,000
		^{137}Cs	<4.6
		^{Total}U	0.065
Tumbleweeds	200-East Area (2)	^{60}Co	<8.4
		^{90}Sr	8,100
		^{137}Cs	<10
		^{238}Pu	<5.5
		^{239,240}Pu	<5.5
		^{Total}U	0.078

Table 3.2.10. (contd)

Sample Type	Collection Area (Number of Samples)	Elevated Radionuclide	Maximum Concentration, pCi/g
Tumbleweeds	200-West Area (2)	^{60}Co	<2.6
		^{90}Sr	1,300,000
		^{137}Cs	0.67
		^{238}Pu	<1.0
		$^{239,240}Pu$	<1.0
		$^{Total}U$	0.09
Freshwater clams	200-East Area (1) (50-g sample, shell and body)	^{60}Co	<9.0
		^{90}Sr	10
		^{137}Cs	<13
		^{238}Pu	<0.26
		$^{239,240}Pu$	<0.26
		$^{Total}U$	0.018
Caterpillar	200-East Area (1)	^{60}Co	<340
		^{90}Sr	3,300
		^{137}Cs	<450
		^{238}Pu	<150
		$^{239,240}Pu$	<150
		$^{Total}U$	0.029
Honey bee comb	200-East Area (1) (not including honey)	^{60}Co	<0.049
		^{90}Sr	1,800
		^{137}Cs	16
		^{238}Pu	<0.84
		$^{239,240}Pu$	<0.84
		$^{Total}U$	0.01
Darkling beetles	200-West Area (1) (10-g sample)	^{60}Co	<110
		^{90}Sr	160
		^{137}Cs	<180
		^{238}Pu	<44
		$^{239,240}Pu$	<44
		$^{Total}U$	0.047
Western toad	100-N Area (1) (whole body)	^{60}Co	46
		^{90}Sr	310
		^{137}Cs	850
		^{238}Pu	62,000
		$^{239,240}Pu$	120,000
		$^{Total}U$	0.057
Gopher snake	200-East Area (1) (whole body)	^{60}Co	<0.73
		^{90}Sr	230
		^{137}Cs	61
		^{238}Pu	<0.56
		$^{239,240}Pu$	<0.56
		$^{Total}U$	0.00013

Table 3.2.10. (contd)

Sample Type	Collection Area (Number of Samples)	Elevated Radionuclide	Maximum Concentration, pCi/g
Pigeon feces	200-West Area (1)	^{60}Co	<0.095
	(0.2-kg sample)	^{90}Sr	3.0
		^{137}Cs	5.4
		^{238}Pu	<0.07
		$^{239,240}Pu$	<0.07
		$^{Total}U$	380
Owl pellets	200-West Area (1)	^{60}Co	<0.16
	(1.0-kg sample)	^{90}Sr	8.4
		^{137}Cs	2.2
		^{238}Pu	<0.70
		$^{239,240}Pu$	<0.70
		$^{Total}U$	43
Starlings	100-K Area (6)	^{60}Co	0.16
	(2 samples)[(a)]	^{90}Sr	96
		^{137}Cs	84
		^{238}Pu	0.65
		$^{239,240}Pu$	1,000
		$^{Total}U$	0.0004
Northern pocket gopher	200-West Area (2)	^{60}Co	<0.62
		^{90}Sr	6,000
		^{137}Cs	<1.5
		^{238}Pu	0.94
		$^{239,240}Pu$	0.63
		$^{Total}U$	0.002
Mouse feces	200-East Area (2)	^{60}Co	<1,100
	(10-g samples)	^{90}Sr	640,000
		^{137}Cs	15,000
		^{238}Pu	<660
		$^{239,240}Pu$	<660
		$^{Total}U$	0.16
Mouse feces	200-West Area (1)	^{60}Co	62,000
	(10-g sample)	^{90}Sr	7,800,000
		^{137}Cs	490,000
		^{238}Pu	18,000
		$^{239,240}Pu$	82,000
		$^{Total}U$	130
Mouse urine[(b)] (wipes from traps)	3000 Area (2)	^{60}Co	<30
		^{90}Sr	7,700
		^{137}Cs	<68
		^{238}Pu	<16
		$^{239,240}Pu$	<16
		$^{Total}U$	0.002

Table 3.2.10. (contd)

Sample Type	Collection Area (Number of Samples)	Elevated Radionuclide	Maximum Concentration, pCi/g
Mouse nest	200-East Area (1)	^{60}Co	<1.3
		^{90}Sr	350,000
		^{137}Cs	810
		^{238}Pu	1.7
		$^{239,240}Pu$	5.6
		$^{Total}U$	0.01
Mouse nest	600 Area (1)	^{60}Co	0.44
		^{90}Sr	74,000
		^{137}Cs	173
		^{238}Pu	<0.5
		$^{239,240}Pu$	<0.5
		$^{Total}U$	0.01
Deer mice	200-East Area (25) (16 samples,[c] whole body)	^{60}Co	<9.1
		^{90}Sr	1,000,000
		^{137}Cs	51,000
		^{238}Pu	4,200
		$^{239,240}Pu$	13,000
		$^{Total}U$	0.37
Deer mice	200-West Area (2) (whole body)	^{60}Co	<1.7
		^{90}Sr	9,300
		^{137}Cs	390
		^{238}Pu	<2.8
		$^{239,240}Pu$	3.0
		$^{Total}U$	0.0019
Deer mice	600 Area (2) (whole body)	^{60}Co	<1.1
		^{90}Sr	11,000
		^{137}Cs	27
		^{238}Pu	<2.0
		$^{239,240}Pu$	<2.0
		$^{Total}U$	0.0004
Deer mouse and wash[b]	3000 Area (1) (whole body)	^{60}Co	<20
		^{90}Sr	1,200
		^{137}Cs	<31
		^{238}Pu	<9.4
		$^{239,240}Pu$	<9.4
		$^{Total}U$	0.0002

(a) Six individuals were collected and combined into two samples.
(b) Picocuries per sample (pCi/sample).
(c) Twenty-five individuals were collected and combined into 16 samples.

241-ER-152 Diversion Box in the 200-East Area. The highest radionuclide concentrations were cesium-137 (7,200 pCi/g) in a sample collected above the inactive pipeline to the decommissioned 216-A-25 Pond north of the 200-East Area and strontium-90 (370 pCi/g) collected west of the 218-W-4B Burial Ground and northeast of the 2401-W Building on the west side of the 200-West Area. Analytical results are provided in Table 3.2.10. The contaminated areas were cleaned up and posted. In addition, 32 incidents of contaminated soil or specks were found during cleanup operations and disposed of in low-level burial grounds.

In 1996, the number of contamination incidents, the range of radiation dose levels, and radionuclide concentrations generally were within historical ranges. Areas of special soil sampling that were outside radiological control areas and had radiation levels greater than radiological control limits (Westinghouse Hanford Company 1991b) were posted as surface contamination areas.

Vegetation

In 1996, four tumbleweed samples, one unidentified vegetation sample, and two moss and lichen samples were analyzed for radionuclide concentrations. Maximum concentrations are provided in Table 3.2.10. The maximum radionuclide concentration (found in 200-West Area tumbleweeds) consisted primarily of strontium-90 (1,300,000 pCi/g). The moss and lichen samples contained a measurable quantity of plutonium-239,240 (120 pCi/g), which bears further investigation to determine if moss and lichens act as environmental “sinks” for radionuclides. In addition, 14 instances of contaminated vegetation (mostly tumbleweeds) were recorded in the operational areas in 1996. This vegetation was discovered during remedial operations, surveyed with field instruments, and disposed of in low-level burial grounds. The field instrument readings for the vegetation ranged from <1 to 210 mrad/h (approximately 100 to >1,000,000 cpm). During 1996, the numbers of contaminated vegetation samples, radioactivity levels, and range of radionuclide concentrations were all within historical ranges (Perkins et al. 1997). Historically, the greatest number of contaminated vegetation samples (42) were submitted for analyses in 1978 (Johnson et al. 1994).

Wildlife

In 1996, 41 wildlife and wildlife-related samples (e.g., feces, nests, etc.) were collected either as part of an integrated pest management program designed to limit the exposure to and potential contamination of animals with radioactive material or as a result of finding a radiologically contaminated animal. Animals were collected directly from, or near, facilities to identify potential problems with preventive measures designed to deter animal intrusion. Surveys were performed after collection to determine whether an animal was radioactively contaminated. If a live animal was found to be free of contamination, it was taken to an area of suitable habitat and released. If an animal was contaminated, a decision was made based on the level of contamination, sampling facility, and frequency of occurrence either to collect the animal as a sample or to dispose of the animal in a low-level burial ground.

Thirty-seven of the 41 special animal samples (50 of the 54 individuals) analyzed in 1996 showed detectable levels of contamination (see Table 3.2.10). This compares to 22 contaminated samples (of 25) that were analyzed in 1995 and 16 (of 27) in 1994. This is not considered an unusual increase because the numbers of samples submitted depended on opportunity (i.e., increased human activity to decommission an inactive facility) rather than exact numbers submitted from established sampling points. The maximum radionuclide concentrations in 1996 were for cobalt-60 (62,000 pCi/g in mouse feces from the 241-S-151 Diversion Box in the 200-West Area); strontium-90 (1,000,000 pCi/g from a deer mouse captured at the 241-ER-152 Diversion Box in the 200-East Area and 7,800,000 pCi/g in mouse feces from the 241-S-151 Vent Station in the 200-West Area); cesium-137 (51,000 pCi/g in mouse feces from the 200-East Area and 490,000 pCi/g in mouse feces from the 241-S-151 Diversion Box in the 200-West Area); plutonium-238 (4,200 pCi/g in a deer mouse captured at the Plutonium-Uranium Extraction Plant in the 200-East Area, 18,000 pCi/g in mouse feces from the 241-S-151 Diversion Box in the 200-West Area, and 62,000 pCi/g in a Western toad collected at the 105-N Basin in the 100-N Area); and plutonium-239,240 (13,000 pCi/g in a deer mouse from the Plutonium-Uranium Extraction Plant, 82,000 pCi/g in mouse feces at the 241-S-151 Diversion Box, and 120,000 pCi/g in a Western toad collected at the 105-N Basin in the 100-N Area). The increased number of animals submitted for analyses in 1996 was primarily due to an investigation of contaminated deer mice at the 241-ER-152 Diversion Box in the 200-East Area. There were 16 contaminated mice at this facility alone that were captured and analyzed, with the analytical results indicating elevated concentrations of strontium-90 (1,000,000 pCi/g) and cesium-137 (51,000 pCi/g). Pest control operations continued for 10 days after the last contaminated mouse was captured, and the area was cleaned up and resurfaced with clean gravel.

A contaminated deer mouse captured at the 1301 Building in the former 3000 Area was notable because the building had been transferred to the Port of Benton and was being used as a food bank and is not near any potential radionuclide source. Pest control operations at the facility led to the capture of the mouse, which was submitted for a radiological survey as a routine precaution. It was determined that the contaminated mouse most likely relocated with food collected from one of the operations areas. Extensive trapping found no other mice, contaminated or otherwise, in the building. No food was found to be contaminated as a result of this incident. The building no longer serves as a food bank.

Contaminated animal samples, which were somewhat atypical for the special sample program, included a caterpillar, a honey bee comb, darkling beetles, long-eared owl pellets, and a Western toad. Samples of freshwater clams, even though not contaminated according to field instrument measurements, were submitted for analyses because they were located in a potentially contaminated waste-water basin. The analytical results indicated very low levels of strontium-90 (10 pCi/g). Sample results are summarized in Table 3.2.10.

An increased interest in the northern pocket gopher's activity was raised during a lawsuit against former Hanford Site contractors by people living downwind of the Hanford Site. Two pocket gophers (one captured near the stabilized 216-T-4 Pond and the other in the 218-W-4A Burial Ground Complex, both in the 200-West Area) were submitted for radionuclide analyses. Analytical results for both pocket gophers indicated measurable levels of strontium-90 (3,000 and 6,000 pCi/g, respectively) but other radionuclides were either less-than values or well below background concentrations.

Additionally, there were 15 cases of contaminated wildlife or related samples (e.g., nests or feces) found during cleanup operations that were not analyzed. The numbers of animals found to be contaminated with radioactivity, the radioactivity levels, and the range of radionuclide concentrations were within historical ranges (Johnson et al. 1994).

Special Characterization Sampling

Special characterization projects were conducted or completed in 1996 to verify the radiological and, in some cases, potential hazardous chemical status of several operations. These included the following:

- continued monitoring of ambient air to determine the levels of diffuse fugitive air emissions at four liquid waste disposal sites (116-B-1, B-4, B-5, C-1) in the 100 Areas. The preliminary analytical data and those from the nearby routinely monitored 1301-N Liquid Waste Disposal Facility indicated that emissions from these facilities were below levels of regulatory concern.

- completed preoperational monitoring support of solid waste operations complex projects (Waste Receiving and Packaging and the Central Waste Complex) in the 200-West Area. Issued the *Preoperational/Operational Environmental Survey Report: Solid Waste Operations Complex* (Mitchell and Johnson 1996), completing the 2-year preoperational environmental monitoring survey for these projects. The analytical data did not identify any environmental concerns that would delay startup of the facilities.